

What is claimed is:

1 1. A method for use in recognizing the content of a media program, said method
2 comprising the steps of:
3 filtering each first frequency domain representation of blocks of said media
4 program using a plurality of filters to develop a respective second frequency domain
5 representation of each of said blocks of said media program, said second frequency
6 domain representation of each of said blocks having a reduced number of frequency
7 coefficients with respect to said first frequency domain representation;
8 grouping frequency coefficients of said second frequency domain representation
9 of said blocks to form segments; and
10 selecting a plurality of said segments.

1 2. The invention as defined in claim 1 wherein each grouping of frequency
2 coefficients of said second frequency domain to form a segment represents blocks that are
3 consecutive in time in said media program.

1 3. The invention as defined in claim 1 wherein said plurality of filters are
2 arranged in a group that processes a block at a time, the portion of said second frequency
3 domain representation produced by said group for each block forms a frame, and wherein
4 at least two frames are grouped to form a segment.

1 4. The invention as defined in claim 1 wherein said selected segments correspond
2 to portions of said media program that are not contiguous in time.

1 5. The invention as defined in claim 1 wherein said plurality of filters includes at
2 least a set of triangular filters.

1 6. The invention as defined in claim 1 wherein said plurality of filters includes at
2 least a set of log-spaced triangular filters.

1 7. The invention as defined in claim 1 wherein the segments selected in said
2 selecting step are those that have largest minimum segment energy.

1 8. The invention as defined in claim 1 wherein the segments selected in said
2 selecting step are selected in accordance with prescribed constraints such that said
3 segments are prevented from being too close to each other.

1 9. The invention as defined in claim 1 wherein the segments selected in said
2 selecting step are selected for portions of said media program that correspond in time to
3 prescribed search windows that are separated by gaps.

1 10. The invention as defined in claim 1 wherein the segments selected in said
2 selecting step are those that result in the selected segments having a maximum entropy
3 over the selected segments.

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1 11. The invention as defined in claim 1 further comprising the step of
2 normalizing said frequency coefficients in said second frequency domain representation
3 after performing said grouping step, said normalization being performed on a per-segment
4 basis.

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1 12. The invention as defined in claim 11 wherein said normalization step includes
2 performing at least a preceding-time normalization.

1 13. The invention as defined in claim 11 wherein said normalization is step
2 includes performing at least an L2 normalization.

1 14. The invention as defined in claim 1 further comprising the step of storing said
2 selected segments in a database in association with an identifier of said media program.

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1 15. The invention as defined in claim 14 further comprising the step of storing in
2 said database information indicating timing of said selected segments.

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1 16. The invention as defined in claim 1 wherein said first frequency domain
2 representation of blocks of said media program is developed by the steps of:
3 digitizing an audio representation of said media program to be stored in said
4 database;
5 dividing the digitized audio representation into blocks of a prescribed number of
6 samples;
7 smoothing said blocks using a filter; and
8 *converting said smoothed blocks into the frequency domain, wherein said*
9 smoothed blocks are represented by frequency coefficients.

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1 17. The invention as defined in claim 16 wherein said filter used in said
2 smoothing step is a Hamming window filter.

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1 18. The invention as defined in claim 16 wherein each of said smoothed blocks
2 are converted into the frequency domain in said converting step using a Fast Fourier
3 Transform (FFT).

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1 19. The invention as defined in claim 16 wherein each of said smoothed blocks
2 are converted into the frequency domain in said converting step using a Discrete Cosine
3 Transform (DCT).

1 20. A method for identifying the content of a media program, comprising the
2 steps of:

3 comparing a digital representation of the content of said media program to be
4 identified with digital representations of the content of a plurality of media programs
5 stored in a database; and

6 identifying the content of said media program to be identified as the one of said
7 media programs having a digital representation of its content stored in said database that
8 most closely matches said digital representation of the content of said media program to
9 be identified.

1 21. A method for use in recognizing the content of a media program, comprising
2 the steps of:

3 filtering a first frequency domain representation of said media program using a
4 plurality of filters to develop a second frequency domain representation of said media
5 program having a reduced number of frequency coefficients in said second frequency
6 domain representation with respect to said first frequency domain representation;

7 grouping ones of said second frequency domain representation to form segments;
8 and

9 selecting a plurality of said segments.

1 22. Apparatus for use in recognizing the content of a media program,
2 comprising:

3 a plurality of filters for filtering a first representation of said media program using
4 frequency coefficients to develop a second representation of said media program that has
5 a reduced number of frequency coefficients with respect to said first representation;

6 means for grouping ones of said coefficients of said second representation to form
7 segments; and

8 means for selecting a plurality of said segments.

1 23. Apparatus for use in recognizing the content of a media program, comprising:
2 means for filtering a first frequency domain representation of said media program
3 using a plurality of filters to develop a second frequency domain representation of said
4 media program having a reduced number of frequency coefficients in said second
5 frequency domain representation with respect to said first frequency domain
6 representation;
7 means for grouping ones of said second frequency domain representation to form
8 segments; and
9 means for selecting a plurality of said segments.

1 24. A method for use in recognizing the content of a media program, said
2 method comprising the steps of:
3 filtering each first frequency domain representation of blocks of said media
4 program using a plurality of filters to develop a respective second frequency domain
5 representation of each of said blocks of said media program, said second frequency
6 domain representation of each of said blocks having a reduced number of frequency
7 coefficients with respect to said first frequency domain representation;
8 grouping frequency coefficients of said second frequency domain representation
9 of said blocks to form segments; and
10 searching a database for substantially matching segments, said database having
11 stored therein segments of media programs and respective corresponding program
12 identifiers.

1 25. The invention as defined in claim 24 further comprising the step of indicating
2 that said media program cannot be identified when substantially matching segments are
3 not found in said database in said searching step.

1 26. The invention as defined in claim 24 wherein said data base includes
2 information indicating timing of segments of each respective media program identified
3 therein, and wherein a match may be found in said searching step only when the timing of
4 said segments produced in said grouping step substantially matches the timing of said
5 segments stored in said database.

1 27. The invention as defined in claim 24 wherein said matching between
2 segments is based on the Euclidean distances between segments.

1 28. The invention as defined in claim 24 further comprising the step of
2 identifying said media program as being the media program indicated by the identifier
3 stored in said database having a best matching score when substantially matching
4 segments are found in said database in said searching step.

1 29. The invention as defined in claim 28 further comprising the step of
2 determining a speed differential between said media program and a media program
3 identified in said identifying step.

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1 30. The invention as defined in claim 28 wherein said matching score for a
2 program P_i is determined by $P_i = \frac{1}{Z} \sum_{j=1}^Z f(S'_j - S_j(P_i))$.

1 31. The invention as defined in claim 28 further comprising the steps of:
2 repeating said filtering, grouping, searching and identifying; and
3 determining, in the event of another match, whether said identified program is the
4 same program determined prior to said repetition or a different program.

1 32. The invention as defined in claim 31 wherein said determining step is based
2 on an overlap score.

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1 33. The invention as defined in claim 32 wherein overlap score is calculated
2 between said program determined prior to said repetition, P0, and said program
3 determined during said repetition, P1, is calculated as

4 Overlap score = $(t_{\text{end}} - t_{\text{begin}}) / (\text{end time of P1} - \text{beginning time of P1})$

5 where

6 t_{end} is min(end time of P0, P1); and

7 t_{begin} is max(beginning time of P0, P1).

1 34. A method for use in recognizing the content of a media program, said method
2 comprising the steps of:

3 filtering a first frequency domain representation of said media program using a
4 plurality of filters to develop a second frequency domain representation of said media
5 program having a reduced number of frequency coefficients in said second frequency
6 domain representation with respect to said first frequency domain representation;

7 grouping ones of said second frequency domain representation to form segments;
8 and

9 searching a database for substantially matching segments, said database having
10 stored therein segments of media programs and respective corresponding program
11 identifiers.

1 35. Apparatus for use in recognizing the content of a media program, comprising:
2 means for filtering a first frequency domain representation of said media program
3 using a plurality of filters to develop a second frequency domain representation of said
4 media program having a reduced number of frequency coefficients in said second
5 frequency domain representation with respect to said first frequency domain
6 representation;

7 means for grouping ones of said second frequency domain representation to form
8 segments; and

9 means for searching a database for substantially matching segments, said database
10 having stored therein segments of media programs and respective corresponding program
11 identifiers.

1 36. The invention as defined in claim 35 wherein said first frequency domain
2 representation of said media program comprises a plurality of blocks of coefficients
3 corresponding to respective time domain sections of said media program and said second
4 frequency domain representation of said media program comprises a plurality of blocks of
5 coefficients corresponding to respective time domain sections of said media program.

1 37. A computer readable storage arranged to store segments derived from, and
2 representative of, various media programs, said segments of each respective one of said
3 media programs being stored in said database so as to be associated with a respective
4 media program identifier.

1 38. The invention as defined in claim 37 wherein each of said media program
2 identifiers is unique.

1 39. The invention as defined in claim 37 wherein each of said segments is
2 developed by

3 filtering a first frequency domain representation of said media program using a
4 plurality of filters to develop a second frequency domain representation of said media
5 program having a reduced number of frequency coefficients in said second frequency
6 domain representation with respect to said first frequency domain representation;

7 grouping ones of said second frequency domain representation to form said
8 segments

1 40. A method for identifying a media program to be identified, the method
2 comprising the steps of

3 comparing segments of said media program to be identified with segments
4 representative of various media programs that are stored in a database, said segments of
5 each respective media program stored in said database being stored in association with a
6 respective media program identifier; and

7 identifying said media program to be identified with the media program identifier
8 that is associated with the stored segments that most closely matches said segments of
9 said media program to be identified.

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